



# Robert **Bird** Group

## North Ryde Station Precinct

## M2 Site

## Civil Design Report

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## **1.0 Introduction**

### **1.1 Background**

This report has been prepared in support of State Significant Development SSD-5093 for the Stage 1 Preliminary Works associated with the North Ryde Station Precinct M2 Site. These works include the superlot subdivision, civil infrastructure, public domain works and other associated works of the M2 site.

The M2 site is legally described as Lot 101 DP 1131776 and is bounded by the M2 Motorway to the east, Epping Road to the south west, Delhi Road to the south and by Wicks Road to the north. The M2 total site area is 91,530m<sup>2</sup> and the land generally slopes down to the north, towards Wicks Road. The northern portion of the site also contains a small creek known as Porters Creek.

### **1.2 Document Scope**

This Civil Design Report has been prepared by Robert Bird Group (RBG) who are engaged by UrbanGrowth NSW (UG NSW) to provide civil engineering consultancy for the project. The following report is in support of the State Significant Development (SSDA) documentation for the public infrastructure works, which will involve:

- Site Preparation Works:
  - Erosion and sediment control;
  - Bulk earthworks; and
  - Site re-grading
- Works associated with roads and intersections:
  - Geometric design of internal roads;
  - Pavement design;
  - Signs and Linemarking design; and
  - External intersection upgrades
- Upgrade of pedestrian pathway and cycle way networks both internal and external of the site
- Drainage and Water Sensitive Urban Design (WSUD)
- Augmentation of existing drainage networks to mitigate flooding risk
- Services reticulation

Reference is made throughout the report to the Civil Design Drawings, which are provided under separate cover.

## 1.3 References and Inputs

Referenced documents include:

- North Ryde Station, M2 Site Stormwater Management Plan (SWMP), RBG, October 2014.
- Flood Assessment, Emergency Vehicle Access via Wicks Road and Waterloo Road and Justification for no On-Site Detention, Cardno, April 2014
- JK Geotechnical Investigation, 9 July 2014 Reference 27484Prpt
- Phase 1 Contamination Report, Douglas Partners, April 2014
- Remediation Action Plan, Douglas Partners, April 2014
- Topographical Survey, Project Surveyors, October 2014
- TIDC Development Sites Report of Impacts on Epping to Chatswood Rail Line, Doc# PR\_6437, August 2008;
- TIDC ECRL Underground Infrastructure Guidelines, May 2008;
- North Ryde Station Precinct Development Control Plan, 4 December 2013 (DCP 2013)
- City of Ryde Development Control Plan 2010 (DCP 2010)
- Macquarie Park Floodplain Risk Management Study & Plan, April 2010 (Bewsher 2010).
- Macquarie Park Floodplain Risk Management Study & Plan, February 2011 (Bewsher 2011)
- Australian Human Rights Commission – Accessible Bus Stop Guidelines (2010)
- Disability (Access to Premises – Building) Standards 2010.

## 1.4 Existing Site Description and Conditions

The M2 Site, North Ryde is located within the City of Ryde local government area and is bound by the M2 Motorway to the east, Delhi Road to the south, Epping Road to the south-west, Wicks Road to the north, and low rise commercial/industrial buildings to the west. Refer Figure 1 for an aerial image of the site. The area is an irregular shaped land parcel covering approximately 9 hectares and is approximately 600m long and 150m wide. Site levels slope down to the north with a difference in level of approximately 28m, which is an average slope of approximately 5%.

Bushland occupies the northern part of the site and Porters Creek runs parallel to Wicks Road within the bushland area. The Epping to Chatswood Railway Line (ECRL) tunnels pass under the southern end of the site, the alignment of which is indicated in Figure 1.

At the time of this report, the site was occupied by Leighton Contractors and the Epping to Thornleigh Third Track (ETTT) Alliance as a works compound. There is an access road running north to south on the western side of the site, with entry/exit at the intersection of Wicks Road and Waterloo Road. Temporary construction access has also been provided from the M2 Motorway on-ramp to the east of the site. There are site sheds and parking areas to the south with stockpiles of excavated material occupying the centre of the site. A large concrete lined water settling basin is located at the lower levels of the worked area and appears to be maintained to treat runoff from the construction site.



**Figure 1 – Aerial Site Image & ECRL Zones**

### **Epping to Chatswood Rail Line (ECRL)**

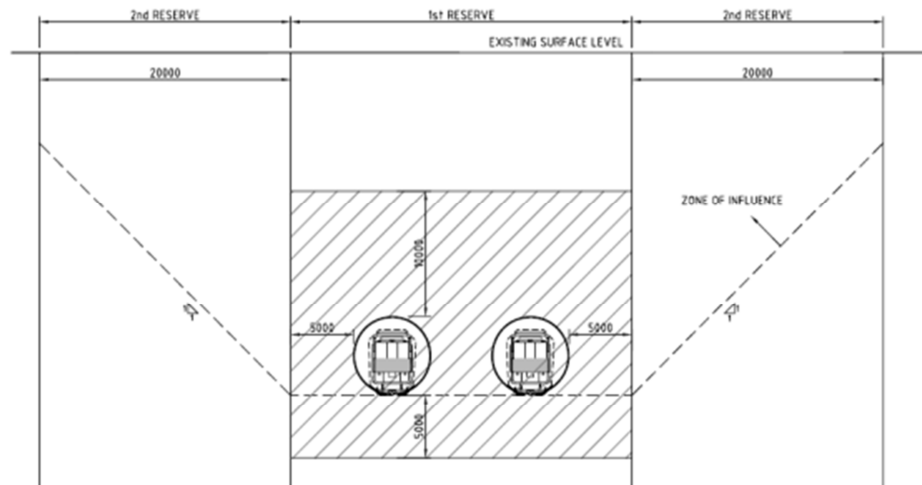
Twin tunnels forming part of the Epping to Chatswood Rail Line (ECRL), are located below the Site and provide development constraints which have been considered in the design.

ECRL Underground Infrastructure Protection (ECRL UIP) Guidelines, Report # 20007300/ PO-4532, dated 06 May 2009, Revision 4, provides the protection requirements and constraints on construction activities and building development in the vicinity of the ECRL. Specifically:

- Section 3.1 describes the 'Reserve Zones;
- Drawing (PRL GD 02467-02604) details the extents of the reserve zones; and
- Section 3.4 provides details of Development Guidelines. The guidelines limit excavations, footings and foundations within the zones and provide advice as to when detailed geotechnical evaluations need to be undertaken for certain construction activities.

Typically the reserve corridor is 70m wide, consisting of a 30m wide (typical) '1<sup>st</sup> Reserve' located over the ECRL tunnels, with a further 40m comprising the remaining '2<sup>nd</sup> Reserve Zone' (20m either side of the 1<sup>st</sup> Reserve). The Reserve zones are shown on the Civil Engineering, Bulk Earthworks design drawing (C-0-2-01).

The 1<sup>st</sup> Reserve is also defined vertically to extend 10m above the crown of the tunnels. The ECRL UIP Guidelines Drawings PRL GD 02475-02477 provide longitudinal sections of the alignment across the development, and details of the depth from existing ground level to 1st reserve zone can be identified. A typical section through the tunnel showing the extent of the 1<sup>st</sup> and 2<sup>nd</sup> Reserve Zones is shown in Figure 2.



**Figure 2 – Typical Section through ECRL running tunnels  
(Sourced from the ECRL Protection Guidelines PRL-GD-02600-1.)**

The ECRL UIP Guidelines highlight that construction within the First Reserve zone, directly over or within 5m horizontally of the tunnels should be limited to shallow excavations and light loadings (maximum 3m deep excavations and maximum 150kPa bearing pressure footings). Development in this zone which could result in higher loads would require a detailed analysis of impacts of the proposed construction. The Second Reserve zones extend to 20m horizontally either side of the first reserve and to a depth indicated by the zone of influence shown in Figure 2. Development inside the Second Reserve will also be constrained, but to a lesser degree. It is noted that deep foundations can be located in the Second Reserve subject to founding below the zone of influence and de-bonding of piles. The net effect of any construction in either of the reserve zones must not adversely affect the ECRL.

Further information on ECRL infrastructure and constraints to development are provided in the following reports:

- TIDC Development Sites Report of Impacts on Epping to Chatswood Rail Line, Doc# PR\_6437, August 2008;
- TIDC ECRL Underground Infrastructure Guidelines, Doc#20007300/PO-4532, May 2008.

### Utilities

Potholing, service scanning, survey and Dial-Before-You-Dig (DBYD) information have confirmed the presence of gas, electricity, telecommunications, sewer, water and stormwater present along the Wicks Road and Epping Road corridors adjacent to the site. A high pressure gas main traverses the site diagonally from Wicks Road to the M2 Motorway site boundary, where it continues south, parallel to but outside the site limits. This gas main is not critical to the supply of the site and discussions are underway with the service provider, Jemena, regarding relocation of this main. A water main enters the Site from Wicks Road at the vicinity of the Wicks and Waterloo Road intersection. Refer to the site survey plans in the Civil Engineering drawings for the location of known existing services.

### Existing Structures

The Site includes an area of land acquired from Lot 2 (DP 528488) which fronts Epping Road and is currently occupied by a building (North Ryde Smash Repairs). The M2 Site works include only the eastern portion of this land parcel, however does not include the existing building. The demolition of the building is not part of the proposed works.

There is an existing drainage culvert in Porters Creek under the access road at the northern end of the site running parallel to Wicks Road. The culvert is to be retained and extended as part of the proposed works.

Areas of pavement exist on site, including a concrete hardstand at the temporary construction access from the M2 on-ramp. Remaining pavements are to be demolished and disposed as part of the subdivision works.

### Geotechnical

Geotechnical investigations and reporting has been undertaken for the Site, including Douglas Partners (May 2014) and JK Geotechnics, (9 July 2014). The purpose of the geotechnical investigations was to advise on ground conditions for structural and civil works.

The Douglas Partners report provides a Geotechnical Model, which is presented as Table 1 below and is confirmed by the JK Geotechnics report. The model indicates deep filling overlying silty clay, with shale, siltstone and sandstone below. Extremely low to medium strength rock was encountered at relatively shallow depths. Medium to high strength bedrock was encountered at depths of 10m to 40m.

The borehole data obtained from both geotechnical investigations has been used to generate a geotechnical model for earthworks modelling.

**Table 1 Site Geotechnical Model**

Unit	Material	Description
1	<b>Filling</b>	Deep filling was encountered in the majority of the borehole locations across the site to depths of 1.0m to 3.0m.
2	<b>Silty Clay</b>	Hard silty clay identified at several borehole locations, to depths of 1.9m and 2.2m (up to 1.9m thick).
3	<b>Shale, Siltstone and Sandstone (Mittagong Formation)</b>	Extremely low to very low strength shale and siltstone to depths of 3.0m to 3.7m was encountered in boreholes at the southern end of the site.
		Low to medium strength siltstone to depths of 5.1m to 6.0m in boreholes at the very south of the site.
		Extremely low to low strength, fine grained sandstone to depths of 2.1m to 4.25m.
4	<b>Sandstone (Hawkesbury Sandstone)</b>	Medium to high strength sandstone, moderately to slightly fractured to unbroken with depth, was proven to depths of 9.55m to 41m. Some very low strength bands were encountered at various depths.

Douglas Partners noted that historical documents reference a decline and shaft, which were large open excavations during the construction of the ECRL to facilitate the entry of equipment. It has been reported that the decline had rock bolts installed as temporary support when it was an open excavation and the excavation has been backfilled with a concrete plug and filling. For buildings over the decline, special attention will be required on the foundations so that they are not affected by the decline.

## 2.0 Civil Works

The civil works consists of the following elements:

- Site preparation and clearing;
- Erosion and sediment control;
- Earthworks;
- Roads, pavements, signs and linemarking;
- Utility services; and
- WSUD and stormwater drainage.

### 2.1 Site Preparation and Clearing

Site preparation will generally consist of the following:

- Detailed site services investigation confirming location of all utility assets, establishment of construction management plans, including addressing any requirements set by Transport NSW for protection of ECRL assets (refer ECRL UIP Guidelines);
- Implementation of site specific environmental and construction management plans i.e. establish site compound, install sediment and erosion control devices, etc;
- Site clearing and demolition of redundant structures and utilities; and
- Stripping of any vegetation and unsuitable material for disposal at an appropriate disposal facility or by redistribution on site. Stockpiling of materials deemed suitable for reuse i.e. milled pavements for reuse as fill material

The existing site access road and culvert will require progressive demolition to facilitate the proposed construction of the roads and stormwater drainage. Service relocations will be required to facilitate the construction of the Epping Road and Wicks Road intersections.

## 2.2 Erosion and Sediment Control

### 2.2.1 Codes, Guidelines and Specifications

The erosion and sediment control design of the project has been carried out in accordance with the relevant local, state and national design guidelines, and Australian Standard Codes of Practice. These include, but are not limited to the following:

- AS 1289 Methods of Testing Soils For Engineering Purposes;
- AS 3798 Guidelines on Earthworks for Commercial and Residential Developments;
- AS 4678 Earth Retaining Structures; and
- Managing Urban Stormwater: Soils and Construction, Landcom ('The Blue Book').

## 2.2.2 Erosion and Sediment Control Strategy

An erosion and sediment control plan has been prepared for the Site based on existing survey data and geotechnical information. The Preliminary Geotechnical Report indicates that “*natural site soils are of high plasticity clays with a relatively high potential for movement with changes in moisture content*”. As such, Type F soil category has been adopted for design (as defined in the Blue Book).

The erosion and sediment control measures for the site are staged in accordance with the anticipated development stages:

1. Bulk Earthworks and removal of excess cut material; and
2. Construction of roads and public domain works;

The erosion and sediment control measures proposed for the M2 site include:

- Sediment basins with sediment storage volume and “clean water channel” catch drains for discharge into Porters Creek;
- Sediment fences around stockpiles and construction zones where soils are exposed;
- Catch drains/bunds to collect construction site runoff and convey flows to the sediment basin; and
- Sediment protection devices on existing and proposed inlet pits i.e. filter socks.

Temporary roads providing construction and vehicle access to sediment basins enable regular maintenance and sediment removal. Soil management measures shall be in accordance with City of Ryde Council DCP 2010 Part 4.5 Section 6.3.4.

Refer to the North Ryde Station Precinct Stormwater Management Plan, RBG, October 2013 for further details.

## 2.3 Earthworks

### 2.3.1 Codes, Guidelines and Specifications

The earthworks design of the project has been carried out in accordance with the relevant local, state and national design guidelines and the Australian Standard Codes of Practice including but not limited to the following:

- AS 1289 Methods of Testing Soils For Engineering Purposes;
- AS 3798 Guidelines on Earthworks for Commercial and Residential Developments;
- AS 4678 Earth Retaining Structures
- Managing Urban Stormwater: Soils and Construction, Landcom (‘The Blue Book’); and
- ECRL Underground Infrastructure Protection Guidelines.

Table 2 provides preliminary geotechnical design criteria adopted for developing site grading and earthworks. Refer the JK report ‘*Geotechnical Investigation for Proposed Multi-Storey Residential Subdivision, Waterloo Road, Macquarie Park, NSW 9 July 2014*’, for detailed requirements for site preparation and earthworks.

Table 2 Preliminary Geotechnical Parameters – Earthworks	
Parameter	Design Criteria
Interface batters on graded lots	Minimum grade – 1% (100:1) Maximum grade – 25% (4:1)
Excavation batters (H:V) (for batter heights up to 2m)	Clayey fill, natural clayey soils, low strength shale – 1:1 (temporary), 1:2 (permanent) Sandy fill, natural clayey sands – 1:1.5 (temporary), 1:2 (permanent) Shale, medium strength sandstone – 1:1 (temporary), 1:1 (permanent)
Fill	300mm thick layers compacted at 98% SMDD up to 500mm below proposed subgrade level. 500mm below proposed subgrade levels to be compacted to 100% SMDD. Moisture content to be controlled within optimum < 2%

### 2.3.2 Earthworks Strategy

The overarching earthworks strategy is to deliver a suitably graded site for future development, whilst minimising the quantum of excess material, and thereby minimising costs. This requires the consideration of road boxing depths, temporary construction batters for retaining walls, a 400mm box out to the Central and Linear Park areas, and temporary sedimentation basins.

The Earthworks Strategy is based on the preliminary cut and fill analysis shown on design drawings C-0-2-01 and C-0-2-02. This analysis estimates a total cut volume of 41,650m<sup>3</sup> and a fill volume of 16,300m<sup>3</sup>.

From the above calculation, an estimated excess of 25,230m<sup>3</sup> has been estimated to require removal off the site. To save on disposal costs, it is anticipated that the exported material will consist primarily of Virgin Excavated Natural Material (VENM) and Excavated Natural Materials (ENM). It is expected that the naturally occurring Shale, Sandstone, Siltstone and clay deposits will be suitable to export from site under these classifications. However it is not known whether the areas of existing fill can also be classified as natural material or if it will be classified as General Solid Waste (GSW).

In the event that the site cut cannot be disposed of as ENM, it is anticipated that over excavation of VENM will be required from below the design formation level in order to achieve the net volume of spoil.

It is noted that the estimated volumes above do not include and bulking of materials during excavation, or for multiple handling of materials as described.

## 2.4 Roads and Pavements

### 2.4.1 Codes and Specifications

The roadworks design of the project has been carried out in accordance with the relevant local, state and national design guidelines and Australian Standard Codes of Practice including but not limited to the following:

- AS1428 Design for Access and Mobility
- AS 1742 Manual of Uniform Traffic Control Devices Parts 1 to 15
- AS 2890 Parking Facilities, Parts 1 and 2
- AUSTRROADS Guide to Road Design Parts 1 to 8
- AUSTRROADS Guide to Geometric Design of Rural Roads
- AUSTRROADS Guide to Traffic Engineering Practice Parts 1 to 14 (SAA HB69)
- AUSTRROADS Vehicle Turning Templates
- AUSTRROADS Pavement Design – A Guide to the Structural Design of Road Pavements
- AUSTRROADS APRG Report No.21 - A Guide to the Design of new Pavements for Light Traffic
- RMS Road Design Guide
- RMS Delineation Guidelines
- RMS Guide to Signs and Markings
- RMS Shared Zone Policy and Guidelines
- Cement & Concrete Association of Australia: Industrial Floors and Pavements: Guidelines for Design Construction and Specification.
- NSW Department of Planning – North Ryde Precinct Development Control Plan 4 December 2013.
- Australian Human Rights Commission – Accessible Bus Stop Guidelines (2010)
- City of Ryde Council
  - Council Development Control Plan 2010 – Parts 8.3. 9.2
  - Environmental Standards Development Criteria, Section 4, Public Civil Works (draft)

## 2.4.2 Design Criteria

The following design criteria have been adopted for the road design:

Table 3 Roads and Pavement Design Criteria	
Parameter	Design Criteria
<b>Roads</b>	
Road Classifications	<p><u>Spine Street</u> - Collector with buses.</p> <p><u>Park Street, Plaza Street, Retail Street</u> – Local Access, with buses considered for clockwise circulation only.</p> <p>Mews Roads, Crossovers and Driveway Access - Heavy duty crossings.</p>
Design Vehicle	<p>12.5m bus for proposed bus route (clockwise circulation within site) with a 15.0m kerb to kerb turn radius at 15km/hr unless noted otherwise on swept path plans.</p> <p>19m semi-trailer accessing Lot 104 from the Epping Road slip lane, and via an 'out-and-back' route along Spine, Park and Plaza Streets. Noting this latter route requires lane sharing. With a 15.0m kerb to kerb turn radius and speed of 15km/hr unless shown otherwise on swept path plans.</p> <p>8.8m medium rigid truck for all other movements.</p>
Check Vehicle	19m semi-trailer, noting that lane sharing will be required for this vehicle. With a 15.0m kerb to kerb turn radius and speed of 15km/hr unless noted otherwise on swept path plans.
Design Vehicle by Intersection	<p><b>Wicks Road / Waterloo Road</b> All turning movements designed for 19m semi-trailer, except left turn from Wicks to Waterloo Road, which is designed for a 12.5m rigid vehicle. And a left turn from Waterloo Road to Wicks Road, which is designed for an 8.8m rigid vehicle. Note lane sharing required in some instances.</p> <p><b>Spine Street / Park Street</b> Spine (southbound) to Park (eastbound) design for 12.5m rigid truck/bus &amp; checked for 19m semi-trailer. Park (westbound) to Spine (southbound) 8.8m rigid truck. All other movements design for 12.5m rigid truck/bus and checked for 19m semi-trailer.</p> <p><b>Spine Street / Retail Street</b> Retail (westbound) to Spine (southbound) designed for 8.8m rigid vehicle. All other movements designed for 8.8m rigid vehicle &amp; checked for 12.5m rigid truck/bus</p> <p><b>Spine Street / Epping Road:</b> Epping (southbound) to Spine (northbound) designed for 19m semi-trailer.</p> <p><b>Park Street / Plaza Street:</b> Park to Plaza designed for 12.5m rigid truck/bus &amp; checked for 19m semi-trailer. Plaza to Park designed for 8.8m rigid truck/bus &amp; checked for 19m semi-trailer.</p> <p><b>Plaza Street / Retail Street:</b> Plaza to Retail designed for 12.5m rigid truck/bus &amp; checked for 19m articulated bus. Plaza to Lot 104 designed for 8.8m rigid truck &amp; checked for 19m semi-trailer All other movements designed for 8.8m rigid truck &amp; checked for 12.5m rigid truck/bus.</p>
Operating Speeds	Design – 60KPH, Posted – 50KPH**

Table 3 Roads and Pavement Design Criteria	
Parameter	Design Criteria
Design Traffic Loading (Equivalent Standard Axle)	Spine Street – 3.0 x 10 <sup>6</sup> ESAs Park Street, Plaza Street, Retail Street– 1.0 x 10 <sup>6</sup> ESAs 5% heavy vehicles, 1% annual growth, 2.1 axle groups per heavy vehicle. TLD distribution as per WIM Site 600 (Warringah Rd, Forestville) Austroads Appendix D Guide to pavement technology.
Pavement Design Life	40 Years
Design Subgrade California Bearing Ratio (CBR)	CBR 3.5***

\* Design and Check Vehicles by intersection. Refer to engineering plans C-0-3-40 to C-0-3-42 for Swept Path Analysis

\*\* Speed environment to be controlled by appropriate signage, speed humps, street furniture and pavement finishes

\*\*\* As nominated in the JK Geotechnical Report

### 2.4.3 Design Gradients

The design gradients for roads are in accordance with the Ryde City Council Environmental Standards Development Criteria, Section 4, Public Civil Works (draft).

Footpaths have been designed to have 2.5% crossfalls in accordance with the Disability (Access to Premises) Standards. Refer to Civil Engineering drawings for design grading.

### 2.4.4 Materials

For Epping Road, materials shall be in accordance with RMS specifications. All other pavement materials shall be in accordance with the Ryde City Council Environmental Standards Development Criteria, Section 4, Public Civil Works. Refer to the Civil Engineering drawings for typical construction details.

### 2.4.5 Roads and Pavement Proposal

The road design includes internal roads, internal intersections, and intersections with existing roads external to the site. These are described in further detail below (to be read in conjunction with the design drawings):

#### 2.4.5.1 Spine Street

Spine Street is a 520m long collector road which provides all vehicular access to the site via Epping Road to the south and the Wicks Road and Waterloo Road intersection to the north. Spine Street is typically 6.5m wide (two lanes), with additional 2.5m parking lanes on each side for on-street parking. Roadside footpaths are provided, other than where a detached shared use path is provided in public open space (Lot 111) on the eastern side of the road. The total road reserve width is generally 17.5m.

The road is generally crowned at 3% crossfall to direct surface water to dish drains on either side (separating the traffic lanes from the parking bays). A 3% superelevation has been provided at the southern Spine Street bend, which has a minimum 90m radius in line with AUSTRROADS standards. Spine Street has a maximum longitudinal gradient of less than 8%.

A 3.25m wide bus stop lane will be provided in each direction with suitable turning space and tactile indicators for disabled users. Due to site constraints, the road longitudinal gradient does not allow for these stops to be fully compliant with the Accessible Bus Stop Guidelines which are aligned to the Disability Discrimination Act (DDA) in terms of fall across the bus stops. A bus shelter will be provided adjacent to the northbound bus stop which would be expected to be the preferred stop for boarding passengers.

Spine Street has two internal road intersections with Park and Retail Street, and access to residential development lots are provided by vehicular crossovers. Development lots 201 to 204 are separated from the Spine Street carriageway by the public open space (Lot 111), and as such the 7.0m wide driveway crossovers will be constructed from the road carriageway to the development lot boundaries. It is proposed that the crossovers are located within the road reserve rather than crossing the public open space.

The southern section of Spine Street will be one-way (northbound) as the intersection with Epping Road will allow for vehicular entry only.

#### **2.4.5.2 Park Street / Plaza Street / Retail Street**

Park Street, Plaza Street and Retail Street join together to form a two way loop road.

Park Street is 163m long and joins Spine Street to Plaza Street. The road is 6.5m wide (two lanes), with 2.5m wide parking lanes. A 4.5m wide shared use path on the northern side, and a 1.5m footpath on the southern side will be provided to give a total road reserve width of 17.5m. Park Street has a maximum longitudinal grade of 4.3%.

Plaza Street is 95m long and joins Park Street to Retail Street with right-angle bends at either end. The road is 9.75m wide, consisting of two general traffic lanes and a bus lane. Plaza Street is proposed to have 3.0m shared path on the eastern side, and a 2.5m wide footpath on the western side to give a total road reserve width of 16.75m. The road crossfall is designed to slope westwards to assist drainage but has relatively flat longitudinal grades of 1.5%. Plaza Street will have a natural stone pavement (granite cobbles or similar - refer to Landscape Architect details). Two bus passenger set down and layover areas are provided on the eastern side of the road, and one dedicated boarding stop. All three stops are DDA compliant and able to operate independently of each other for buses up to 18m (bendy bus). All service buses will be required to use the loop road in a clockwise direction.

Retail Street is 136m long and is located within the proposed 'mixed use' zoned area of the site (between Lots 104 and 105). The 6.5m wide road has 2.5m wide parking lanes and 4m wide footpaths on each side to give a total road reserve width of 19.5m. It has a longitudinal gradient of 1.5% to the east increasing to 4.8% where it intersects with Spine Street.

#### **2.4.5.3 Future Connection Road**

Provision has been made in the design for a potential future connecting road to be constructed within Lot 109 which connects Spine Street (via the industrial land to the west of the Site) to Wicks Road. Lot 109 is 17.5m wide, consistent with other road reserves in the proposal, to allow for a road and intersection to be designed in the future. It should be noted however, that this road does not form part of this SSDA application.

#### **2.4.5.4 Waterloo Road**

In accordance with the recommendations made by the Cardno Flood Assessment (Ref. 59914099-L01), Wicks Road will be regraded to remove a local low point west of the Waterloo Road / Spine Street intersection.

The north-west kerb return on the intersection of Wicks and Waterloo Road will also be widened to allow for 12.5m HRV turning movements. To the west of the intersection Wicks Road will be widened by approximately 1m to allow for 4 no. lanes at 3.2m widths. No other widening will be provided on Wicks Road to the east of the Spine Street intersection, nor to Waterloo Road.

#### **2.4.5.5 Epping Road**

The existing Epping Road service lane will be narrowed using kerb blisters to provide a continuous width of 3.5m (gutter lip to gutter lip). Footpaths and existing driveways are to be modified accordingly, and the existing bus stop is to be relocated to the position indicated on engineering drawing C-2-3-00.

The bus stop will be DDA compliant, with the exception of the steeper longitudinal grade of the existing road which is to be maintained. Alternative locations have been considered, however moving the stop further to the west to the nearest point where the road is at the maximum desirable gradient would place the relocated bus stop within 200m of an existing stop further to the west and would reduce accessibility to the existing retail on Epping Road and to the M2 site.

The mixed use development lot (Lot 104) will be provided with dedicated entry and exit driveways from Epping Road. Exit to Spine Street is as indicated on drawing C-0-3-01.

#### **2.4.5.6 Pavements and Finishes**

Spine Street and portions of Park and Retail Streets are constructed with flexible pavements and finished with a 50mm AC14 wearing coarse. The external Epping Road, Wicks Road and Waterloo Road are to be constructed in accordance with the recently RMS approved deep lift asphalt on a sand/cement subbase also finished with a 40mm AC14 wearing coarse.

The entirety of Plaza Street and the remaining portions of Park and Retail Streets are constructed with a rigid pavement base on a lean concrete subbase. The finishing of these areas is by cobblestone set in accordance with landscape specification.

The remaining components including access driveways and pedestrian footpaths are to be constructed in concrete on sand bedding and finished in accordance with landscape specifications.

In accordance with the JK Geotechnical Investigation, a subgrade of CBR3.5 has been assumed which is proposed to be improved by a 150mm select fill layer of CBR10. This brings the effective subgrade strength up to CBR6. It is noted that some road excavations will be low strength rock / VENM material which is likely to achieve an existing strength of CBR6. Such areas would not require the 150mm select fill layer.

The pavement design is in accordance with the City of Ryde Development Control Plans, AustRoads Guide to Pavement Technology, and the Cement Concrete & Aggregates Australia Guide to Industrial Floors and Pavements. Where these guidelines vary, the greater level of the requirements is incorporated.

#### **2.4.6 Intersections**

##### **Wicks Road / Waterloo Road:**

Spine Street will join the existing priority T-intersection of Wicks Road and Waterloo Road to form a four-way intersection. It is proposed that the new intersection will be controlled by traffic signals including controlled crossings for pedestrians and cyclists (providing continuity of the existing cycle paths to those provided within the site). It is anticipated that the Wicks / Waterloo intersection will be the main vehicular ingress and will be the only vehicular egress from the site.

##### **Epping Road:**

Entry to the site will be provided from the southbound carriageway of Epping Road between the Wicks Road and Delhi Road intersections. A deceleration lane as described in Section 2.4.5 will be formed and this intersection will provide for left turns into the site, and a slip lane for 12.5m HRV's and 19.0m semi-trailer delivery to Lot 104. As such, the section of Spine Street joining Epping Road will be one-way (northbound only) up to the other proposed vehicular entry to Lot 104.

##### **Pedestrian facilities:**

Pedestrian footpaths and crossings will be provided within the site. Zebra crossings have been provided in four locations around the site, with two raised crossing on Spine Street, and one on-grade crossing on each of Park, Plaza and Retail Streets.

Additionally, the existing footpath along the northern side of Epping Road (along Lot 104) is in disrepair and is to be reconstructed and widened to 1.6m as part of the works.

## 2.4.7 Parking and Signage

On-street parking has been provided throughout the development in accordance with with AS 2890. Signage and linemarking has been provided throughout and external to the site in accordance with AS 1742. Refer to the signs and line-marking engineering drawings C-0-5-00 to C-0-5-06 for the proposed layouts.

Sign post locations will be coordinated with street lighting poles where possible to avoid signage clutter in the footway.

## 2.5 Utility Services

The Site will be supplied with electricity, potable water, sewer, gas and telecommunications services in accordance with the relevant authority requirements. Street lighting will be provided for the roads and public open spaces in accordance with City of Ryde Council standards. All services will be located within the road reserve verges and footpaths, except for sewerage, which is proposed to be located in the public open space areas and along the western site boundary.

Combined services plans have been provided on engineering drawings C-0-9-01 to C-0-9-07. Which supplement the individual services designs. Some lead-in works to augment existing services adjoining the Site are required. This is addressed under separate cover from this report.

## 2.6 WSUD and Stormwater Drainage

### 2.6.1 Codes and Specifications

The stormwater design of the project will be carried out in accordance with the relevant local, state and national design guidelines (were not over-ridden by Ryde City Council requirements) and Australian Standard Codes of Practice including but not limited to the following:

- AS 3500.3.1 National Plumbing and Drainage Part 3.1: Stormwater Drainage – Performance Requirements
- AS 3500.3.2 National Plumbing and Drainage Part 3.2: Stormwater Drainage – Acceptable Solutions
- Australian Rainfall and Runoff (AR&R)
- Landcom Water Sensitive Urban Design (WSUD) guidelines
- City of Ryde Council
  - Development Control Plan 2010
  - North Ryde Station Precinct – Development Control Plan 2013
  - Environmental Design Guidelines – Civil Works (draft)
  - Engineering Standard Details

## 2.6.2 Design Criteria

Table 4 provides the design criteria to be adopted for stormwater design, including the design outcome achieved with in the proposed design.

Table 4 Stormwater Drainage Design Criteria		
Parameter	Design Criteria	Design Outcome
<b>Drainage</b>		
Drainage design	Rational Method in accordance with Australian Rainfall & Runoff (AR&R)	
Minor Design Storm – network design	20 YR ARI storm event (Council standard is 50 YR ARI, however it has been agreed previously that 20 year ARI is appropriate in a master planned and controlled development of this nature).  100 YR ARI storm event has been adopted for network design in the area adjacent to Porters Creek to minimise overland flow affecting the Wicks Road / Waterloo Road Intersection.	
Major Design Storm - overland flow	100 YR ARI storm event	
Pipe Sizing	Minimum diameter - 375mm Minimum grade 0.5%. Maximum grade to be selected to comply with maximum velocities (as below).	Min 375 Min 0.8%
Pipe Velocities	Minimum 0.8 m/s. Preferred Minimum 1.0 m/s Maximum 7.0 m/s. Preferred Maximum 5.0 m/s	Min 0.69m/s Max 4.98m/s
Water Quality*	90% reduction of Gross Pollutants 85% reduction of Total Suspended Solids 65% reduction of Total Phosphorus 45% reduction of Total Nitrogen	100% 86% 68% 55%

\* In accordance with the City of Ryde DCP (2014) and Landcom WSUD guidelines

Refer to the RBG Stormwater Management Plan for details of the Water Sensitive Urban Design (WSUD) and stormwater management strategy.

The principles for the site stormwater management are summarised as follows:

- The proposed design does not include On-Site Detention (OSD) for the road reserve and public open spaces, in accordance with the findings of the Cardno study. OSD will also not be required for private allotments unless the proposed development exceeds the maximum impervious ratio which has been defined for each type of land use. Refer to North Ryde Station Precinct, M2 Site Stormwater Management Plan (SWMP), RBG, October 2014.
- Public domain (parks and road reserve) runoff shall be directed to WSUD elements, specifically bio-retention tree pits or rain gardens. WSUD elements shall provide treatment to meet best practice water quality targets. Subsoil and overflow connections shall be provided from WSUD elements to the in-ground drainage network;
- The individual development allotments will be required to demonstrate that they meet the appropriate water quality objectives.

In developing the design, the following assumptions have been made:

- Bridge landing WSUD treatment is to provide 40m<sup>2</sup> of bioretention (or equivalent).
- Bridge catchment has not been included in the catchment analysis.
- Central Park is to provide a total of 100m<sup>2</sup> of bioretention (or equivalent).
- Wicks / Waterloo base flows and inflows are as per Cardno modelling.
- Sump pits in Linear Park to be coordinated with the Landscape Architect.

### 2.6.3 Wicks Waterloo Intersection Drainage Augmentation

The existing drainage system in the Wicks and Waterloo Road intersection is to be generally augmented in accordance with the Cardno Flood Assessment (Ref. 59914099-L01). The Cardno report, and subsequent alterations to the drainage philosophy, recommends:

- A substantial upgrade of the stormwater drainage system on both sides of Waterloo Road, comprising of enlarged and/or new stormwater conduits with multiple new high capacity inlets
- Upgrading the existing stormwater outfall from Wicks Road to a 2100mm diameter pipe discharging to a drop inlet pit structure with a 3000 x 6000 surcharge grate. This discharges into Porters Creek on the upstream side of Spine Street.
- Construction of a new culvert located under the access road, of the same size as the culvert located in the existing scenario

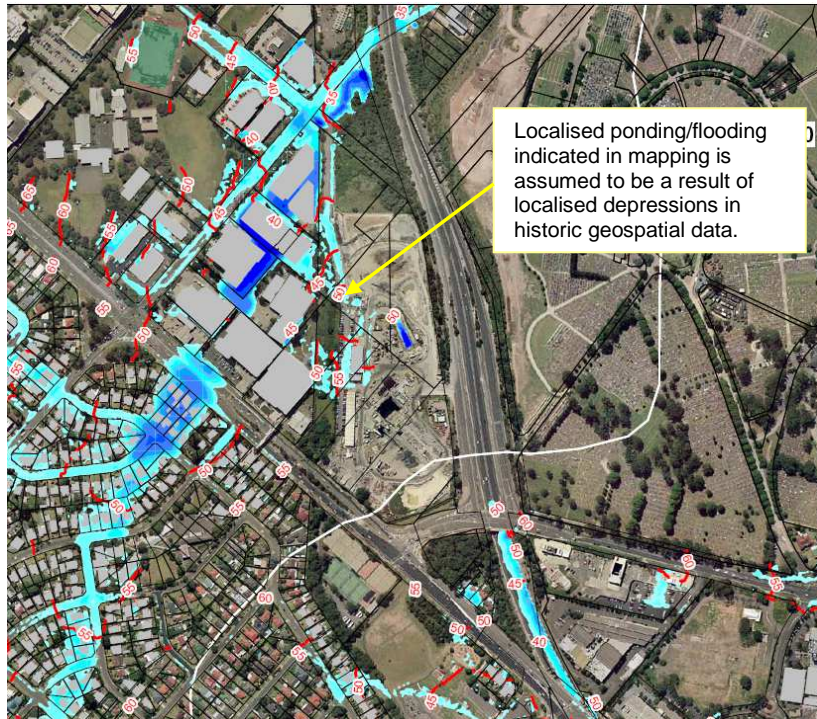
The stormwater drainage upgrade which satisfies these recommendations has been detailed on engineering drawing C-1-6-00 and the Porters Creek Upgrade details has been provided on C-0-6-02. Detail DRAINS models have been compiled which demonstrates the successful management of this intersection in terms of flooding.

## 2.7 Flood Risk

The *Macquarie Park Floodplain Risk Management Study & Plan* by Bewsher Consulting, April 2010 (Bewsher 2010 Report) provides flood mapping for Porters Creek and Lane Cove catchments, including flood levels and extents. The Bewsher 2010 Report was sourced from the City of Ryde Council website.

The Bewsher Report indicated localised flooding risk to the north of the site in the bushland adjacent to Porters Creek (proposed Bush Regeneration Zone, Lot 101) and along the western site boundary as indicated by the following figure. Further modelling of the 100yr flood flow by Cardno indicates that the intersection of Wicks and Waterloo Road and Spine Street requires additional measures to ensure that it is accessible for emergency vehicles. This requires a flood depth  $\leq 0.3\text{m}$  and depth x velocity  $\leq 0.6\text{m}^2/\text{sec}$  in extreme 100yr ARI storm events. The following measures have been proposed to achieve this:

- Augmentation of the existing stormwater pit and pipe systems in Wicks and Waterloo Road to increase the capacity of these systems, and reduce overland flows (refer section 2.6.3)
- Provision of a weir wall and inlet pits on the upstream (southern) side of Spine Street to capture overland flows from the existing industrial lots
- Provision of an inter-allotment stormwater pit and pipe system along the western site boundary to intercept the overland flow. These flows would otherwise contribute to the overland flows in the existing industrial lots
- Provision of a system of 3No. large precast concrete box culverts under Spine Street to convey stormwater to Porters Creek
- One way crossfall at the sag point on Spine Street to facilitate surface flows towards the downstream (northern) side
- Re-grading of Wicks Road to remove a localised low point south of the Waterloo Road intersection



**Figure 2.1 - Simulation of 100 Year ARI Flood (Bewsher 2010 Report)**

## 2.8 Porters Creek Scour Protection

Waterway reshaping and scour protection is required to the Porters Creek Bushland Regeneration Zone as a part of the works. This is in accordance with AR&R, and is discussed under Section 3.4 of the Stormwater Management Plan.

## 3.0 Safety In Design

The initial Safety In Design (SID) risk assessment carried out by RBG on 1 April 2014 has been revised as per the latest engineering plans and architectural layout plans for. The assessment utilised the RBG standard SID toolkit which identified a number of standard hazards associated with civil engineering projects and prompted the designers to consider specific examples of hazards which exist in the context of the project during construction, use, maintenance and decommissioning. Mitigation measures were considered for each hazard and risk scores were assigned based on a combination of the likelihood that the hazard will cause harm and the most probable severity of harm. Hazards were then categorised as low, moderate, significant or extreme based on their risk score.

A Road Safety Audit is being carried out in parallel to the design process.

The SID risk assessment and register has been detailed in the stand alone report – Safety in Design Report dated 28 October 2014.



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